Title: Simultaneous computation of model order and parameter estimation of a heating system based on gravitational search algorithm for autoregressive with exogenous inputs

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Abstract: System identification is a class of control system engineering that determines physical functionality of a plant and represents them in the form of mathematical expression by utilizing real experimental data. It is a process of acquiring, formatting, processing, and identifying mathematical models by considering raw data from the real-world system. Once the mathematical model is chosen, it can be characterized in terms of suitable descriptions such as transfer function that can be used for controller design. Most essential stages of model identification process can be summarized into four main stages. The first stage is collecting experimental data. Then, the model order and structure are chosen. The next stage is to estimate the parameters of the model and finally, the mathematical model is validated. Model order selection and parameter estimation are two significant aspects of determining the mathematical model for system identification. In this paper, an approach termed as Simultaneous Model Order and Parameter Estimation (SMOPE), which is basically based on Gravitational Search Algorithm (GSA), is proposed to combine these two parts into a simultaneous solution. In this technique, both the model order and the parameters of the system are computed simultaneously to obtain the best mathematical model of a system. According to heating system case study, it is proven that the proposed method is outstanding in comparison with some other approaches in literature.